PROGRAMMING ASSIGNMENT - 2

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COT 5405

Overview of Preferential Node Addition and Deletion in Dynamic Models:

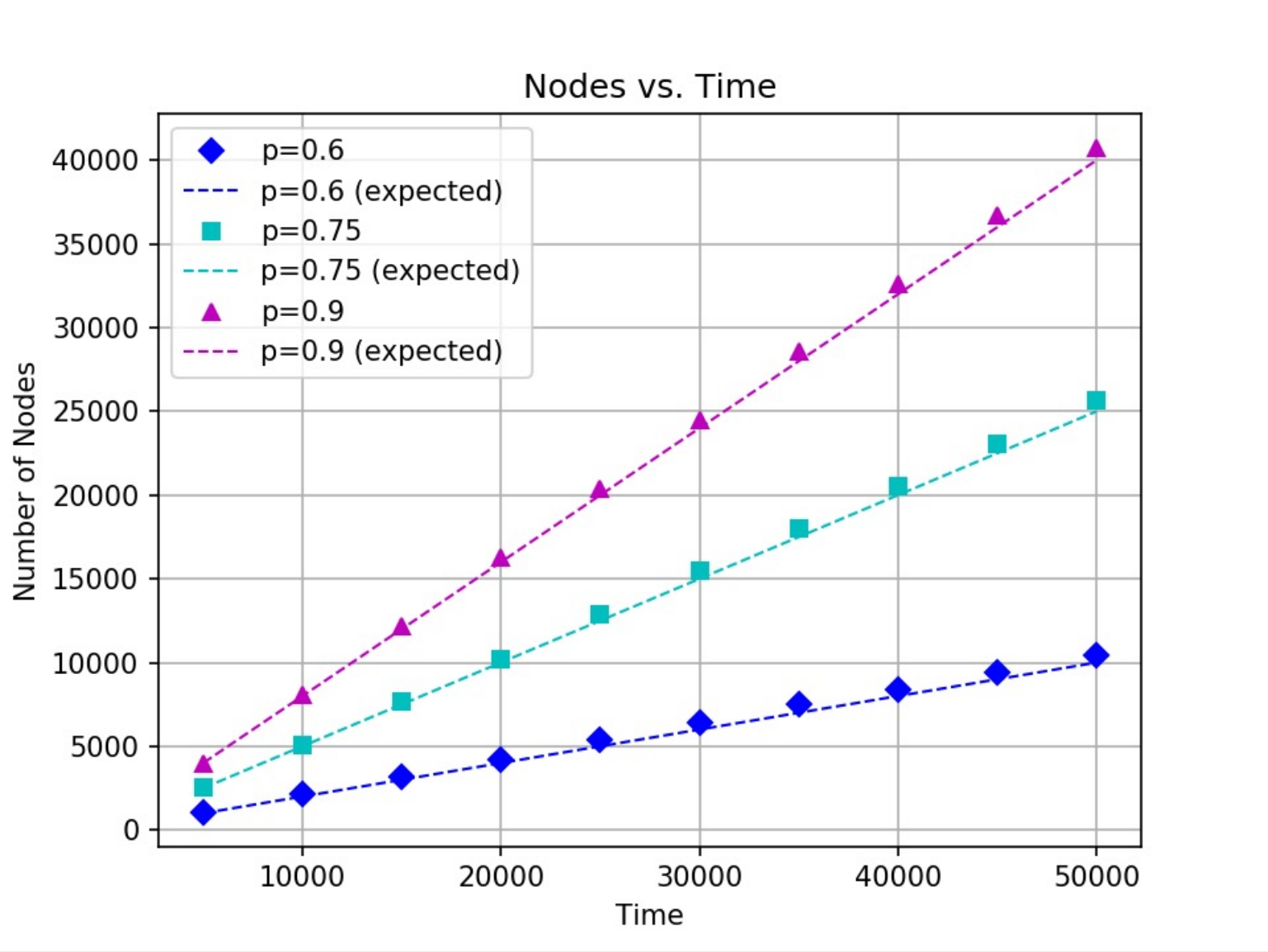
- **Linear Preferential Attachment Rule for Birth Process:** With a probability p, a new node is added along with a new edge incident on it. The other-end (node 'u') to which the new edge will join is chosen based on the probability distribution given by:

  $P_{t+1}[u] = d_t(u) \div (2m_t)$, where t is the discrete time step, $d_t(u)$ is the degree of node 'u' and m_t is the total number of edges in the graph G_t.

- **Linear Preferential Deletion Rule for Death Process:** With a probability q (where q = p - 1), a node 'u' is chosen for deletion along with all the edges incident on it in graph G_t based on the probability distribution given by:

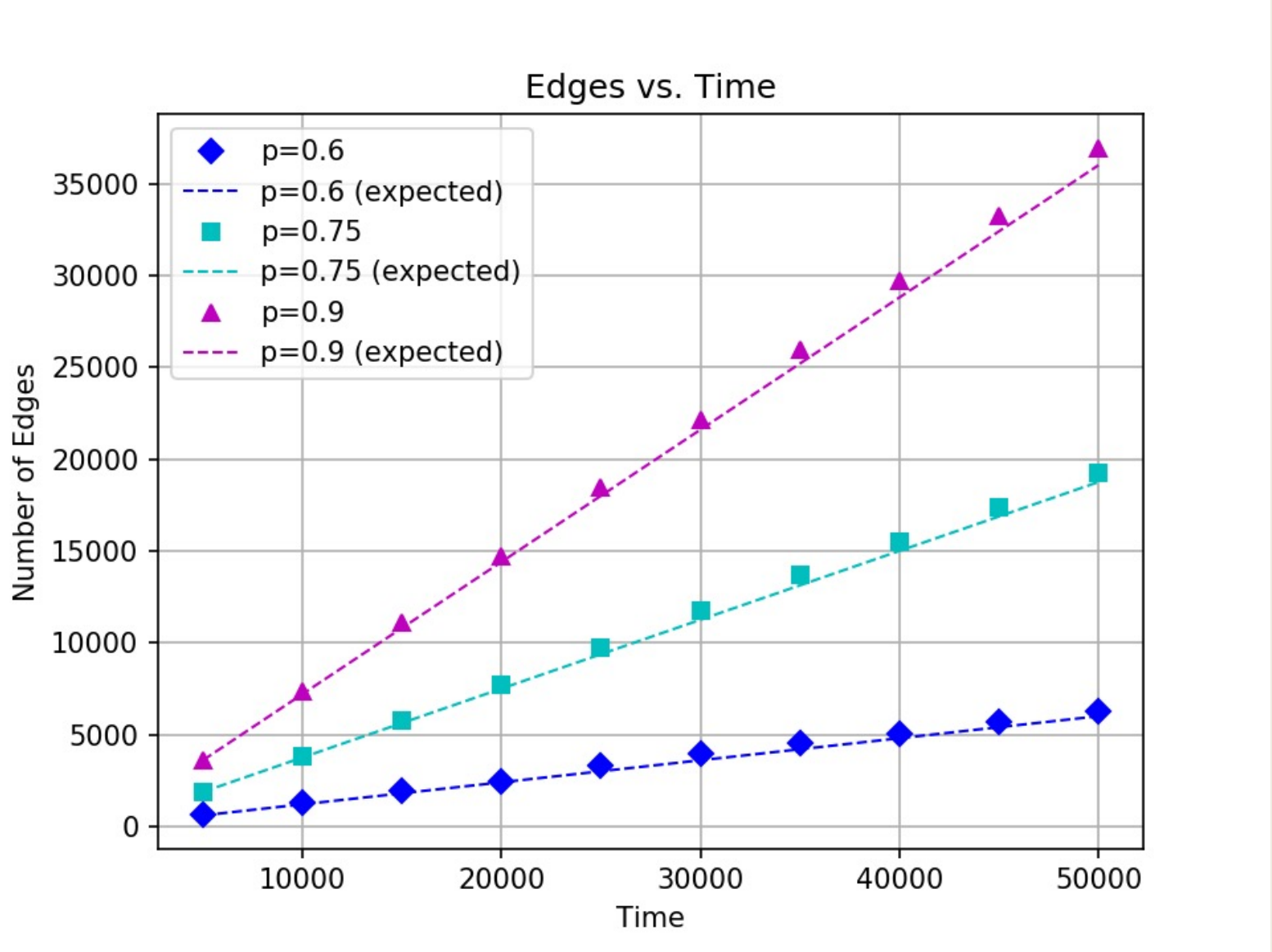
  $P_{t+1}[u] = [n_t - d_t(u)] \div [n_t^2 - (2m_t)]$, where t is the discrete time step, $d_t(u)$ is the degree of node 'u' and m_t is the total number of edges in the graph G_t and n_t is the total number of nodes in the graph G_t.

Distribution of Nodes with change in Time



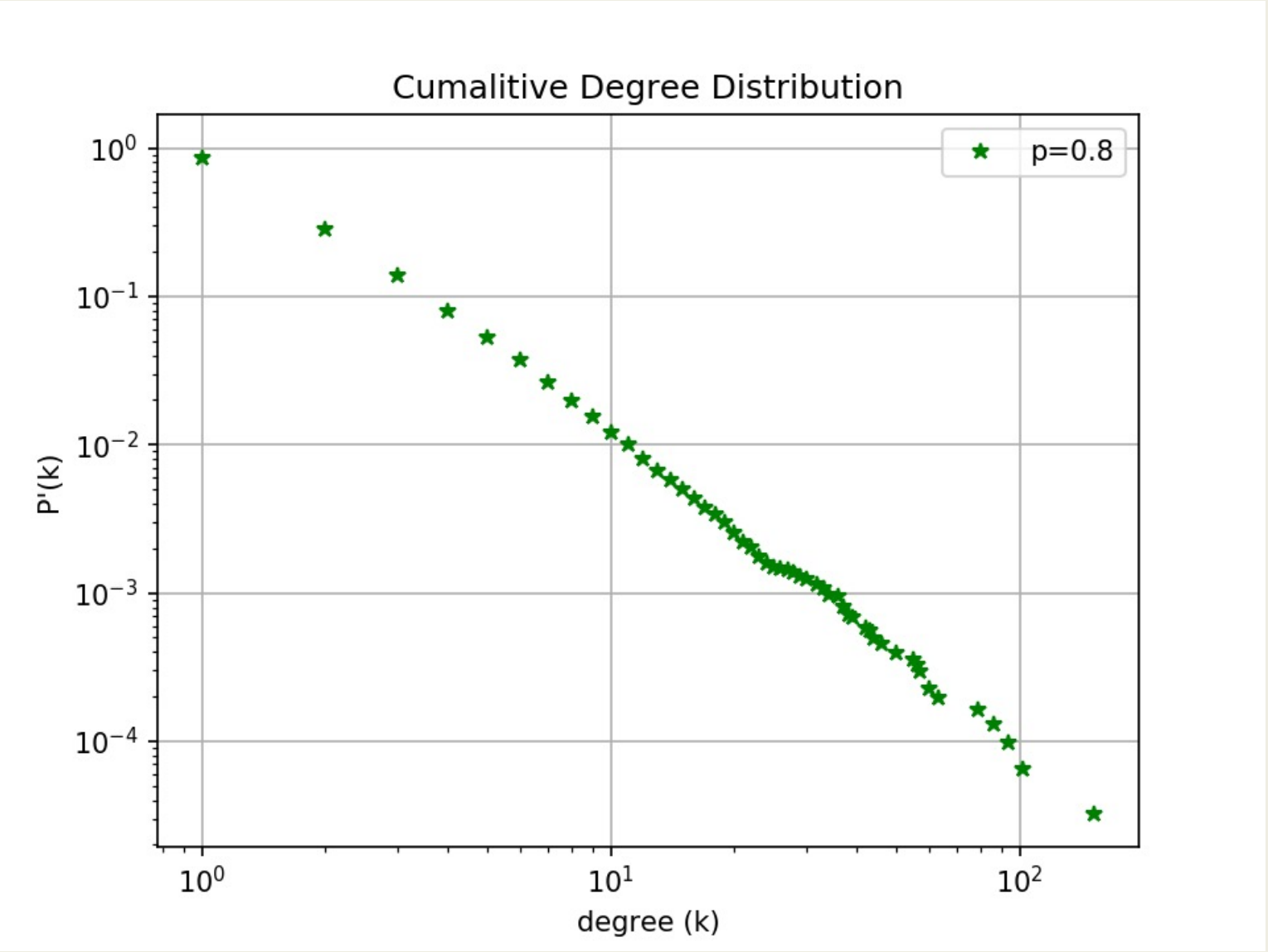
- From the graph, it can be noticed that as time ‘t’ increases, the number of nodes (n_t) in the graph G_t increases linearly.
- The analytical formula to find the find the expected number of nodes with change in t is given by: $E(n_t) = (p - q)t$
  Where p is the probability of adding a node and q is the probability of deleting a node.

Distribution of Edges with change in Time



- From the graph, it can be noticed that as time ‘t’ increases, the number of edges (m_t) in the graph G_t increases linearly.
- The analytical formula to find the find the expected number of nodes with change in t is given by: $E(m_t) = p(p - q)t$ Where p is the probability of adding a node and q is the probability of deleting a node.

Degree Distribution:



- The graph shows the cumulative probability distribution where a randomly chosen node to will have a degree ‘k’.
- It can be noticed that, as degree ‘k’ increases, the probability of finding a node with that value of ‘k’ reduces.
- In order to reduce the statistical noise in the tail of the distribution, P’(k) vs. k has been plotted instead of P(k) vs. k.
  Where $P'(k) = \sum_{i \geq k} P(i)$